impermeable films. Pullulan has numerous applications in pharmaceuticals, foods, environmental pollutant disposal and agriculture [3, 4].

Carboxymethylation of both polymers was done using NaOH 30 % and monocloro-acetate. Since cellulose is insoluble in water unlike pullulan, synthesis of microgel was carried out differently. Ugi reaction then was applied for cross-linking of the obtained microgel.

Microencapsulation; which is the science of trapping components into a secondary material (encapsulant), producing small solid particles (1–500 μm in size) [5]. It was practiced using an emulsion of toluene in water, with toluene being the core material for the microcapsule. The mixture is then dried, producing microcapsules of different diameters and forms depending on the preparation method and materials used.

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## TECHNOLOGICAL ASSESMENT OF ENZYMATIC TREATMENT OF HIGH PROTEIN PRODUCTS*


**Keywords**: Soy, Quinoa, Protein, Enzymatic hydrolysis, ultrasonic pretreatment.


Consumers are increasingly becoming keen on healthy foods, which led researchers to design innovative products enriched with biologically active substances

which adds desired effects or properties to the usual plain product [1]. Among these substances, soy protein products have been widely used due to its promising functional and nutritional values. Soy protein products are an ideal source of amino acids; however, they are exposed to harsh processing conditions such as heat, acids and may lose much of their functionalities [2]. Also Quinoa, one of the most nutritious pseudo-cereals, considered by FAO as one of the potential plants sharing in its plan for the current century's food security due to its gluten-free protein with high amounts of essential amino acids, some of them are even in higher amounts than in Soy [3, 4]. Quinoa is also well-known for the antioxidant properties of its amino acids [5]. Hence, extensive literature is available on the enzymatic modification of soy proteins from moderate to high degree of hydrolysis (DH), but the optimum conditions for hydrolysate production were so far neglected. Therefore, the current research was established to apply different enzymatic hydrolysis of soy proteins at different time. The novelty of the present work was to extract the peptides of both soy and Quinoa peptides with maximum and desired functionalities using microbial proteases. Both commercial soy protein product and Quinoa were treated using acidic protease from *Aspergillus niger* (520 U/ml) (Distizym Protacid Extra, Novozyme) and Neutral protease purchased in SibBioPharm Ltd (Russia). The hydrolysis was conducted to samples with and without ultrasound treatment to observe its effect on hydrolysis.

The experiment was at constant pH and temperature, and degree of hydrolysis (DH) was subsequently estimated and achieved at 0, 30, 60, 120 and 180 minutes. The crude protein content, DH based on free amino nitrogen (FAN) were analyzed using Lowry and Nanhydrin methods photocolometrically, respectively, and results were recorded.

The results revealed that DH using acidic enzymatic treatment typically progressed over the time in both ultrasound-treated and untreated hydrolysates, which were represented by FAN values. Neutral protease demonstrated higher DH values. Compared to untreated hydrolysates, protein content of quinoa was 7.5 times higher than that of the soy hydrolysate according to Lowry method results.

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## APPLICATION OF MAGNETIC NANOPARTICLES, FLUORESCENT NANOPARTICLES AND NANOZYMES IN IMMUNOASSAYS*

**Keywords**: carbon coating, iron nanoparticles, europium, chelate, lanthanide, Prussian blue, horseradish peroxidase.

Magnetic carbon-coated-iron nanoparticles (MNP) were used to develop diagnostic reagents for nuclear-magnetic-resonance-based immunoassays. Clusters of MNP were coated with four different proteins: casein, albumin, gelatins A and B and covalently conjugated with recognition molecules (monoclonal antibodies, streptavidin, protein G etc., fig.1A). Ability of MNP to decrease transverse relaxation time of protons (T2) allows their quantitation with the aid of portable relaxometer (Fig. 1B). One can determine concentration of analyte of interest by measuring T2.

Synthesis of MNP-based nanoconjugates was optimized, size of nanoclusters can be tuned via change of synthesis conditions. Long-term stability of nanoclusters was confirmed; their physical-chemical properties were studied [1].

Fluorescent nanoparticles were prepared by precipitation technique [2] from (Z)-2-hydroxy-4-oxo-4-p-tolyl-2-butenoic acid (HOTBA), europium ions and bovine serum albumin (Fig. 1C). Nanoparticles were covalently conjugated with treptococcal protein G. Long-lived luminescence of nanoparticles ($\lambda_{ex}$ = 350 nm, $\lambda_{em}$ = 620 nm, time delay = 100 ms) was used to develop time-resolved fluorescent immunoassay of IgG.